DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improved Wall Plugs and Methods of Attachment incorporating such Plugs

We, BRITISH INSULATED CALLENDER'S CONSTRUCTION COMPANY LIMITED, a British Company, of 30, Leicester Square, London, W.C.2, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to wall plugs and to methods of attaching brackets and other fittings to walls involving the use of such plugs. The principal object of the invention is to provide an attachment means suitable for use in situations where there is a risk of severe corrosion of metallic parts and more particularly in situations such as tunnels where contaminated water is liable to seep through the wall to which the attachment is made.

In accordance with the invention the wall plug comprises a tube of a suitable pliable synthetic plastics compound or natural rubber or synthetic rubber compound, completely closed at one end and open at the other end to receive a headed pin or expanding bolt, the open end being provided with a cup-shaped extension large enough to receive the head of the pin or bolt and a mastic compound which surrounds and completely covers the head. The term "headed pin" as used herein includes a pin with a detachable head or a pin with a threaded end to which a nut can be applied (before or after the pin has been driven home) the nut functioning in the same way as a head.

We prefer to make the tube of a material which is semi-rigid but is capable of distortion in use but is not liable to flow under stress, for example a hard but pliable rubber or synthetic rubber compound containing an excess of sulphur or other curing agent over and above that required for a soft rubber compound. The cup-shaped part can be made of the same material or of a different corrosion resistant material, it may either be integral with or separable from the open end of the tube. We prefer to form the tube near its open end with an outwardly projecting integral radial flange, in a position such that when the wall plug is in use this flange lies against the wall and is trapped between the surface of the wall and the surface of the member attached to the wall by the pin or bolt.

The invention will be described further with the aid of the accompanying drawings, each of which is a side or longitudinal elevation in section, Figure 1 illustrating a wall plug comprising a pin and Figure 2, a wall plug comprising a bolt of the expanding type.

Referring to Figure 1, the wall plug comprises a tube 1 of generally cylindrical shape and closed completely at one end by an end wall 2 and open at the opposite end. The tube is made of a corrosion resistant material which is capable of some distortion when in use but is not liable to flow under stress. For the tube we prefer to use a hard but pliable rubber or synthetic rubber compound containing an excess of sulphur or other curing agent over and above that required for a soft rubber compound, though other materials may be used, for example plasticized polyvinyl chloride, neoprene or a styrene rubber compound. Spaced at an appropriate distance from the open end of the tube 1, the latter has an external flange 3. This will usually be of circular shape and have a thickness approximating to the thickness of the wall of the main body of the tube. Close to its open end, the tube is provided with a cup-shaped member 4 of generally cylindrical shape and having what may be conveniently

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termed a bottom wall 5 and a side wall 6. The cup-shaped member has an opening 7 and an internal circular recess 8 for the reception of a cover 9, which may be made, for example, of ebonite and be adapted to make a press fit in the recess 8. The bottom wall 5 of the cup-shaped member 4 is provided with a circular aperture 10 so that the cup-shaped member can be placed over the end of the tube 1, the diameter of the aperture 10 being such that the bottom wall 5 makes a sliding fit on the tube. The positions of the flange 3 and of the bottom wall 5 are such as to provide between those members a gap.

The bore of the tube 1 has two diameters of which the smaller extends over the major portion of its length and the larger, over a relatively short length of the tube. The portion of the bore of smaller diameter extends from the inner surface of the end wall 2 of the tube 1 to the adjacent surface of the flange 3 approximately and the portion of the bore of larger diameter extends approximately from the same surface of the flange 3 to the open end of the tube.

The tube 1 is adapted to be inserted into a hole made previously in a wall and the external surface of the tube forced into tight contact with the surrounding part of the wall by driving into the tube a pin 12 which, over the major portion of its length, is of cylindrical shape and of uniform external diameter, this diameter being substantially equal to that of that portion of the bore of the tube 1 lying between the flange 3 and the open end of the tube. The external diameter of the pin 12 over the major portion of its length is thus somewhat greater than the diameter of the bore of the tube 1 over the major portion of the length of the tube. At one end the pin 12 has a cylindrical head 13, the diameter of which is substantially smaller than that of the opening 7 in the cup-shaped member 4 so that when the pin is driven into the tube 1 the head 13 can pass through the opening 7 and lie within the cup-shaped member. The relative dimensions of the cup-shaped member 4 and of the head 13 are such that an ample clearance space is provided between those members when the head occupies its final position within the cup-shaped member. At the opposite end of the pin 12 there is provided a relatively short tapering portion 14, the minimum diameter of which is equal to or approximately equal to that of the smaller diameter of the bore of the tube 1. To permit the escape of air from the tube as the pin is being driven into the tube the latter is provided with a slot 15 which extends from the tapering portion 14 of the pin 12 towards the head 13 and terminates at a short distance from the head. When the wall plug is in use, the final position of the pin 12 within the tube 1 is such that a small space 16 remains between the end wall 2 of the tube and the end of the tapering portion 14.

The figure illustrates the attachment of an electric cable hanger to a wall, the hanger being clear of the ground. A portion of the hanger is indicated by the reference numeral 17, the lower part of the hanger being shown broken away. The wall to which the hanger is attached is indicated by the reference numeral 18 and the free vertical surface of the wall, by the reference numeral 19. In attaching the hanger 17 to the wall, a hole of the appropriate diameter and length is drilled in the wall. The diameter of this hole approximates to that of the external diameter of the tube 1 so that the latter makes a driving fit in the drilled hole. The length of the hole is such that the flange 3 on the tube 1 can be brought into contact with the surface 19 of the wall 18. The hanger 17 has a circular aperture 20 of approximately the same diameter as the external diameter of the tube 1 and is placed over the open end of the tube and brought into contact with the flange 3. The cup-shaped member 4 is then placed over the open end of the tube to bring the bottom wall 5 into contact with the adjacent part of the hanger 17. The length of the tube 1 is such that when the hanger and the cup-shaped member 4 are in position, the tube at its open end projects a short distance into the interior of the cup-shaped member 4 and the width of the hanger 17 is such that it makes a close fit with the flange 3 on one side and with the bottom wall 5 of the cup-shaped member on the other side. The tapering end 14 of the pin 12 is then inserted through the opening 7 into the open end of the tube 1 and the pin driven into the tube by delivering blows to the head 13, this being continued until the head of the pin lies well within the cup-shaped member 4 and beyond the recess 8 in the side wall 6 and is brought into firm contact with the extreme end of the tube 1. This end of the tube is flared outwards at 11 by the head 13. A sealed joint is thus made between the bottom wall 5 of the cup-shaped member 4 and the tube 1. The external diameter of the pin 12 is so related to the bore diameter of that part of the tube surrounded by the hanger 17 that the pin 12 is able to pass freely through that part of the tube. That part of the tube entering the wall 18, however, is forced outwards by the pin 12 and the outer surface of that part of the tube is forced into tight contact with the adjacent part of the wall 18. The tube 1 is thus securely attached to the wall and the

cable hanger 17 secured [redacted]eld in place on the tube. After the head 13 has been brought to its final position within the cup-shaped member 4, the whole of the head is surrounded by a mastic compound 21 and the cover 9 secured in position.

As stated above, the improved wall plug is particularly suitable for attaching fittings to walls in tunnels where contaminated moisture is able to seep through the wall to the attachment means and thereby cause corrosion of the latter. In the present construction moisture seeping through a wall is prevented from reaching any part of the metal pin, the pin proper and the head of the pin both being protected against penetration of moisture. The pin 12 is enclosed for its full length in the tube 1 and the head 13 is totally enclosed in the mastic material 21 and the cup-shaped member 4 is closed by the cover 9 and the bottom wall 5 of the cup-shaped member makes a water-tight joint with the outer surface of the tube 1 at the open end of the latter, and tight contact is maintained between the hanger 17 and the flange 3 and between the hanger and the bottom wall 5 so that moisture cannot penetrate into the aperture 20 in the hanger.

As will be appreciated the head 13 could be separated from the pin 12 and be attached thereto by any suitable means instead of being made integral with the pin and the cup-shaped member 4 could be integral with the tube 1 instead of being made as a separate member.

In the construction illustrated in Figure 1, the tube 1 is forced into tight contact with the surrounding part of the wall 18 by driving the pin 12 into the tube. In the construction shown in Figure 2, the tube 1 of hard but pliable rubber or other plastics material is forced into tight contact with the surrounding part of the wall 18 by a bolt of the expanding type of known construction. The expanding bolt comprises a threaded bolt 22 provided at one end with a head 23 and screwing into a nut 24 having a conical outer surface 25. The head 23 is brought into engagement with a metal washer 26 which abuts against the open end of the tube 1. When placing the bolt in position it is passed through the aperture in the washer 26 until the head 23 abuts the washer. The bolt is then turned in the appropriate direction to cause axial movement of the nut 24 towards the head 23 and the engagement of that nut with a number of arms 27 to force the latter apart into tight contact with the interior surface of the tube 1 and the forcing of the tube into tight contact with the adjacent part of the wall 18, the arms 27 being held together at one end by a metal collar 28. Further turning of the head 23 presses the end of the tube 1 outwards to form a sealed joint between the tube and the bottom wall 5 of the cup-shaped member 4. If an expanded bolt is used, the tube 1 may have a uniform internal diameter sufficient to permit the entry of the bolt before the latter has been expanded. As the amount of expansion of the arms 27 decreases in a direction towards the collar 28 and is a maximum at the opposite end, the bore of the tube 1, after expansion, will have its minimum diameter at the collar 28 and its maximum diameter in the region of the nut 24. Apart from the means for exerting pressure upon the internal wall of the tube 1, the construction in Figure 2 is the same as that shown in Figure 1.

The following is a description of a specific example of a wall plug used for the attachment of an electric cable hanger to a wall and having a cylindrical metal headed pin. The wall plug comprises a cylindrical tube of hard but pliable rubber approximately 5 inches in length and open at one end and closed at the other end. At a point 4 inches from its closed end, the tube is formed on its outer surface with an integral radially projecting flange 1/2 inch in width and about 3/16 inch thick. Between the flange and the closed end of the tube, the wall thickness is 3/16 inch. From the flange to the open end of the tube, the wall thickness of the tube is 1/8 inch and that part of the tube entering the wall has a bore of 5/8 inch diameter and the remainder of the bore has a diameter of 3/4 inch. A cup which is cylindrical and has a diameter of 2 inches and a depth of about one inch is a sliding fit on the open end of the tube. The thickness of the cup wall is about 3/16 inch.

The metal pin is about 4-1/2 inches long and has a diameter of 3/4 inch. At one end it is formed with a cylindrical head fitting inside the cup with a small clearance and at the opposite end it tapers to a diameter of 9/16 inch over a length of about 1/2 inch. From the tapered end to within about an inch of the head, the cylindrical surface of the pin has a longitudinal slot.

The wall to which the hanger is to be attached is drilled to form a one inch diameter cylindrical hole, the tube being driven into this hole until the flange on the tube bears against the surface of the wall. The cable hanger has a one inch diameter hole to enable the hanger to be fitted over the projecting end of the tube. When the cup is placed in position upon the open end of the tube, the thickness of the hanger is such that the tube projects for a short distance into the cup. This projecting part is spread a little when the pin is driven home into the tube, the head of the pin

then being located within the cup. The cup is filled with a setting mastic compound and the cover placed in the recess provided in the inner surface of the cup. For the setting mastic compound may be used, for example, the material marketed by British Insulated Callender's Cables Limited under the Registered Trade Mark "Bitulac".

If the cable hanger or other member supported by the pin or other member is metallic, it will be electrically insulated from the pin or other member by the tube, thus preventing any possibility of bi-metal corrosion.

Where the member to be supported is formed with an aperture large enough to be passed over both the head of the pin or bolt and the cup shaped member, the latter may be formed integrally with the tube. The aperture, for example, may be of keyhole shape consisting of a part with a diameter greater than that of the cup-shaped member adjacent and connected to a part having a diameter equal to the external diameter of the tube, the part of smaller diameter being above the part of larger diameter.

Wall plugs in accordance with the invention may be used for the attachment of fittings to walls of any rigid material capable of being drilled, for example, walls of brick, masonry, solid rock or concrete.

WHAT WE CLAIM IS:—

1. A wall plug for attaching a fitting to a wall, comprising a tube of a pliable synthetic plastics compound or natural or synthetic rubber compound, completely closed at one end and open at the other, the tube having adjacent its open end a cup-shaped extension which is large enough to receive the head of a pin or of an expanding bolt when the pin or bolt is inserted into the tube and a mastic compound surrounding and completely covering the head.

2. A wall plug for attaching a fitting to a wall, comprising a tube of a pliable synthetic plastics compound or natural or synthetic rubber compound, completely closed at one end and open at the other end, the tube having adjacent its open end a cup-shaped extension large enough to receive the head of a pin or of an expanding bolt and a mastic compound surrounding and completely covering the head, the tube also having an outwardly projecting integral radial flange which is so disposed that when the wall plug is in use the flange lies against the wall and is trapped between the wall and the fitting attached to the wall by the pin or bolt.

3. A wall plug for attaching a fitting to a wall, as claimed in Claim 1 or 2, wherein the tube is formed from hard but pliable rubber.

4. A wall plug for attaching a fitting to a wall as claimed in any one of the preceding claims wherein the cup-shaped extension is detachable from the tube.

5. The attachment of a fitting to a wall by the combination of a tube of a pliable synthetic plastics compound or natural or synthetic rubber compound, completely closed at one end and open at the other end where it has a cup-shaped extension, and a plain cylindrical metal pin formed with a head at one end and tapered for a short distance at the opposite end, the cup-shaped extension receiving the head of the pin and a mastic compound surrounding and completely covering the head.

6. The attachment of a fitting to a wall as claimed in Claim 5 wherein the surface of the pin has one or more longitudinal slots extending over the length of that part of the pin entering the wall.

7. The attachment of a fitting to a wall as claimed in Claim 5 or 6 wherein the portion of the bore of the tube that lies inside the wall has a diameter slightly less than that of the pin and the portion of the tube that passes through the fitting has a bore diameter substantially equal to that of the diameter of the pin.

8. The attachment of a fitting to a wall as claimed in any one of Claims 5, 6 or 7 wherein the cup-shaped extension is detachable from the tube.

9. A method of attaching a fitting to a wall, comprising drilling a hole in the wall, inserting a tube of a pliable synthetic plastics compound or natural or synthetic rubber compound into the hole, the tube being completely closed at its inner end and open at its outer end where it projects beyond the wall, placing the fitting to be attached to the wall over the projecting end of the tube, either driving a headed pin into the tube until the head enters a cup on the end of the tube or inserting a bolt of the expanding bolt type into the tube until the bolt head enters a cup on the end of the tube and turning the bolt head to force the tube into hard contact with the surrounding part of the wall, and surrounding and covering the head of the pin or bolt with a mastic compound.

10. A method of attaching a fitting to a wall, comprising drilling a hole in the wall, inserting a tube of a pliable synthetic plastics compound or natural or synthetic rubber compound, having a radially projecting flange into the hole until the flange abuts the wall, the tube being completely closed at its inner end and open at its outer end where it projects beyond the wall, placing the fitting to be attached to the wall over the projecting end of the tube, placing a cup over the end of the tube so that it lies against the fitting, either driving into the tube a headed pin until the head contacts the end of the tube and lies in the

cup and forces outwards[illegible]e open end of the tube to seal the cu[illegible]o the tube, or inserting into the tube a bolt of the expanding type until the bolt head lies in the cup and turning the bolt head to expand the bolt to force the tube into hard contact with the surrounding part of the wall and to form a sealed joint between the cup and the tube, and surrounding [illegible] covering the head of the pin or bol[illegible]th a mastic compound.

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PROVISIONAL SPECIFICATION

Improved Wall Plugs and Methods of Attachment incorporating such Plugs

We, BRITISH INSULATED CALLENDER'S CONSTRUCTION COMPANY LIMITED, a British Company, of 30, Leicester Square, London, W.C.2, do hereby declare this invention to be described in the following statement:—

This invention relates to wall plugs and to methods of attaching brackets and other fittings to walls involving the use of such plugs. The principal object of the invention is to provide an attachment means suitable for use in situations where there is a risk of severe corrosion of metallic parts and more particularly in situations such as tunnels where contaminated water is liable to seep through the wall to which the attachment is made.

In accordance with the invention the wall plug comprises a tube of a suitable pliable synthetic plastic compound or rubber or synthetic rubber compound, completely closed at one end and open at the other end to receive a headed pin or expanding bolt, the open end being provided with a cup-shaped extension large enough to receive the head of the pin or bolt and a plastic compound which surrounds and completely covers the head. The term "headed pin" as used herein includes a pin with a detachable head or a pin with a threaded end to which a nut can be applied (before or after the pin has been driven home) the nut functioning in the same way as a head.

We prefer to make the tube of a material which is semi-rigid but is capable of distortion in use but is not liable to flow under stress. Such a material is that known as "plastic ebonite", which is a rubber or synthetic rubber compound containing an excess of sulphur or other curing agent. The cup-shaped part can be made of the same material or of a different corrosion resistant material, it may either be integral with or separable from the open end of the sleeve. We prefer to form the tube near its open end with an outwardly projecting integral radial flange, in a position such that when the wall plug is in use this flange lies against the wall and is trapped between the surface of the wall and the surface of the member attached to the wall by the pin or bolt.

We prefer to use the wall plug in conjunction with a plain cylindrical metal pin, formed with a head at one end and tapered for a short distance at the opposite end, and to make the part of the tube which lies inside the wall of an internal diameter slightly less than the diameter of the pin and the part of the tube which lies outside the wall (that is the part which passes through the member to be supported) of an internal diameter substantially equal to the external diameter of the pin. Thus, whereas the part of the tube entering the wall will be compressed by the pin against the inner surface of the aperture in the wall, the pin will pass freely through the part of the tube passing through the member to be supported. We prefer to form the surface of the cylindrical pin with one or more longitudinal slots extending over the whole of that part of the pin which enters the wall so that, as the pin is driven into the sleeve, air can escape from the diminishing space between the end of the pin and the closed end of the tube.

The wall plug is particularly suitable for attaching cable brackets and other fittings to tunnel walls and the invention will be further illustrated by a description of an example of an attachment means in accordance with the invention suitable for this purpose.

The wall plug consists of a cylindrical tube of plastic ebonite approximately 5 inches long open at one end and closed at the other end. At a point 4 inches from the closed end, the tube is formed on its outer surface with an integral radially projecting flange 1/2 inch in width and about 3/16 inch thick. Between the flange and the closed end of the tube, the wall thickness is 3/16 inch; the wall thickness of the remainder of the tube (from the flange to the open end) is 1/8 inch thus giving the part of the tube which enters the wall a bore of 5/8 inch the remainder of the bore being 3/4 inch. A 2 inch diameter cylindrical cup about 1 inch deep is a sliding fit on the open end of the sleeve; this cup can conveniently be made of plastic ebonite of about 3/16 inch thickness.

The pin for use in conjunction with this wall plug is about 4-1/2 inches long and 3/4 inch in diameter. At one end it is

formed with a cylindrical head which fits inside the cup with a small clearance and at the opposite end it tapers to a diameter of 9/16 inch over a length of about 1/2 inch. From the tapered end to within about an inch of the head the cylindrical surface of the pin is formed with a longitudinal slot to allow for escape of air as described above.

The wall to which the attachment is to be made is drilled to form a one inch diameter cylindrical hole into which the plug can be driven until its flange bears against the surface of the wall. The cable hanger to be attached to the wall is also provided with a one inch diameter aperture and this aperture is fitted over the projecting end of the plug. The cup is then placed in position on the open end of the plug, the thickness of the cable hanger being such that a short length of the plug tube projects into the cup. This projecting part is spread a little so that as the pin is driven home the end of the tube is trapped against the inner surface of the cup by the head of the pin to form a water-tight joint between the cup and the plug. Finally the head of the bolt is completely protected by filling the cup with a setting plastic compound, for example that marketed by B.I.C.C. Ltd. under the Registered Trade Mark "Bitulac".

Thus the metal pin is completely protected from corrosion. Also, seepage of water from the wall into the aperture in the cable hanger is prevented by the flange which is trapped between the cable hanger and the wall. If the cable hanger or other member supported by the pin is metallic it will be electrically insulated from the pin by the tube, thus preventing any possibility of bi-metal corrosion.

The wall plug described is also suitable for use in conjunction with an expanding bolt, except that in this case it is unnecessary to form the two parts of the tube of different internal diameter.

Where the member to be supported is formed with an aperture large enough to be passed over both the head of the bolt and the cup, this cup can be formed integrally with the open end of the tube; the aperture may for example be of keyhole shape consisting of a part with a diameter greater than the diameter of the cup adjacent to and connected to a part of a diameter equal to the external diameter of the sleeve, the part of smaller diameter being above the part of larger diameter.

The attachment means in accordance with the invention is suitable for use in walls of any rigid material which can be suitably drilled, whether built up for example of brick or masonry, or of solid rock or concrete.

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FIG. 1.

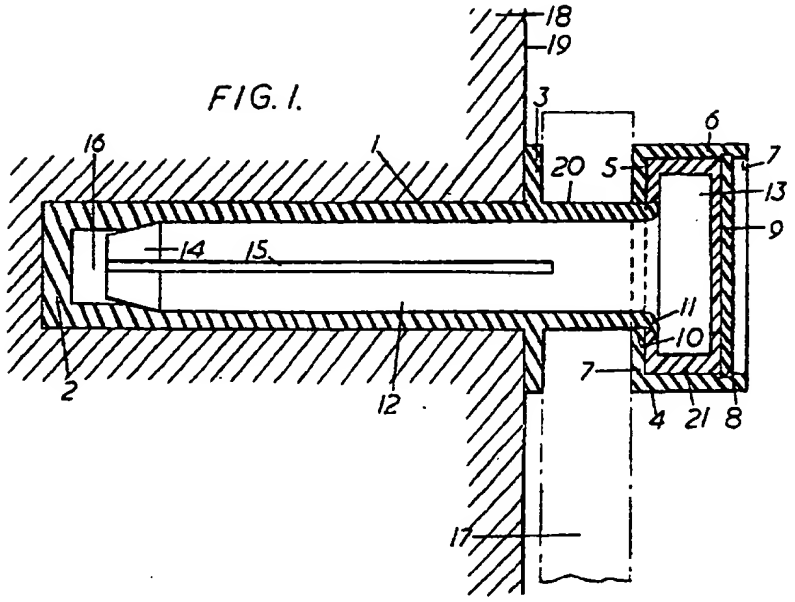

FIG. 2.